November 5, 2018

S P E C I A L P R O V I S I O N

AMENDMENT TO SECTION 510 – BEARING PILES

Item 510.111 – Mobilization and Demobilization of Micropile Drilling Equipment
Item 510.616 – Furnishing and Installing Micropile Permanent Casing
Item 510.617 – Furnishing and Installing Micropile Core Pipe
Item 510.721 – Drilling and Grouting Micropiles

This special provision provides for the micropile construction and neither amends nor modifies other provisions of 510, except as specified herein.

Description

1.1 This work shall consist of furnishing all materials, equipment, labor, and services necessary to construct micropiles for support of the proposed Abutments and associated wingwalls in accordance with this special provision and with details shown on the project plans.

1.2 Micropile Design Considerations.

1.2.1 The specific material requirements for the micropile components are included in Section 2.

1.2.2 The permanent casing shall extend into the footing as specified on the plans. The permanent casing shall extend a minimum of one foot below the top of bedrock. The micropile rock socket length shall be defined as the bottom of the permanent casing to the depth of rock socket specified on the plans.

1.2.3 The micropiles are designed to support axial structural loads through side friction within the rock sockets. The maximum factored micropile compressive axial load is provided in the plans. The lateral loads are supported by a combination of the horizontal component of battered micropiles, and by the bending resistance provided by the permanent casing and, if utilized, a steel core pipe.

1.3 Vibration and Deformation Monitoring. Vibration limits and deformation monitoring of the specified structures as provided through Section 211 shall apply to the micropile construction. The Design-Build Team shall modify the micropile installation procedures, if the vibration limits set by the Vibration Consultant for the specified structures are exceeded, or if any

unacceptable deformation has occurred, as determined by the Engineer. Any damage shall be repaired at the expense of the Design-Build Team.

1.4 Test Boring Logs. The Design-Build Team is advised to review the logs for test borings located in the area of the proposed micropiles that are included in the bridge plans. The Design-Build Team shall be responsible for assessing effect of the bedrock properties on the micropile construction procedures, including the potential for grout loss into the bedrock formation during grouting. These effects shall be accounted for in the contract bid prices for the micropile items. The bedrock core samples from the test borings completed by the Department are in storage at the Materials and Research Bureau (phone number (603) 271-3151), and the cores may be reviewed upon request.

1.5 This work shall be conducted in conformance with all applicable environmental regulations and permits.

Materials

2.1 Permanent Steel Casing Pipe. The permanent steel casing shall have a 9.625 inch O.D., with a minimum 0.545 inch wall thickness.

2.1.1 The steel casing shall conform to API 5CT Grade N80 or better, and shall be new "Mill Secondary" steel pipe without mill certification, assuming it is free from defects (dents, cracks, tears), and has a minimum of two unique coupon tests per 7000 pounds of casing; or "Prime" steel pipe meeting the above API requirements.

2.1.2 The estimated length of the steel casing indicated in the micropile plan notes shall be supplied. Splices that are required for permanent casing shall meet the requirements defined in 2.2.1.

2.2 Steel Core Pipe. The steel core pipe shall have a 6.625 inch OD with a minimum 0.475 inch wall thickness. The steel core pipe shall meet the material requirements defined in 2.1.1.

2.2.1 The estimated length of the steel core pipe indicated in the micropile plan notes shall be supplied. A maximum of one welded splice within the estimated length will be permissible. Threaded splices will not be permissible. Welding procedures shall meet the requirements of the AWS D1.1 Structural Welding Code – Steel Specifications, and shall be submitted for review and approval prior to any welding operation.

2.3 Cement Grout.

2.3.1 Cement grout shall be a non-shrink neat cement or sand/cement mix with a maximum water to cement ratio of 0.45 by weight, a minimum three day compressive strength of 1500 psi, and a minimum 28 day compressive strength of 5000 psi per AASHTO T 106/ASTM C 109.

2.3.2 Water for mixing grout shall conform to the requirements of Section 520.2.5.

2.3.3 Cement shall conform to AASHTO M85/ASTM C150, Type II Portland cement.

2.3.4 Grout strength accelerators shall not be used. Admixtures that control bleed, retard set or modify the grout thixotropic properties to control grout loss into the surrounding ground may be used, subject to approval. All admixtures shall be mixed and placed in accordance with the manufacturer's recommendations.

2.3.5 Appropriate measures shall be taken to preclude freezing of the grout prior to its reaching design strength.

2.4 Centralizer. Centralizers used along the core pipe shall be constructed of Schedule 40 PVC, or other non-corrosive material that is compatible with and as durable as the micropile cement grout, and shall be subject to approval. The centralizers shall be sized to insure that the tolerance criteria for the micropile are met, and shall permit sufficient clearance for grout placement tubes.

Construction Requirements

3.1 Qualifications. The Design-Build Team and the Design-Build Team's project superintendent and drilling equipment operator for the micropile installation work covered under this special provision shall have a minimum three years of experience in constructing micropile foundations within the past five years. The Design-Build Team's project superintendent shall be present at all times during execution of the work covered by this special provision. A summary of the experience and qualifications shall be submitted in writing to the Engineer at least four weeks prior to the start of the micropile installation. The summary shall include the name, address and phone number of the owner's representative who can verify the information provided. The contractor for the micropile work shall be subject to approval by the Engineer.

3.2 Installation Plan Submittal. At least four weeks prior to constructing the micropiles, the Design-Build Team shall submit an installation plan in accordance with 105.02 to the Engineer for review and approval. This plan shall be stamped by a New Hampshire licensed Professional Engineer knowledgeable in the design and construction of micropile foundations.

3.2.1 The Design-Build Team's submittal shall contain as a minimum, the following specific information:

a. Written documentation of the Contractor's qualifications as defined in 3.1.

b. Description of the equipment to be used, including manufacturer's specifications and catalog data for all drilling rigs, drilling tools, permanent casing, grout mixing equipment, grout placement equipment, and all other necessary tools.

c. Description of the micropile installation methods, including procedures for drilling overburden and bedrock, cleaning the drillhole bottom, placing and centering the casing and core pipe, placing grout, restraining the core pipe during grouting,

backfilling any void areas around the permanent casing, and cutting of the permanent casing at the design cut-off grade.

d. The proposed mix design and test results for the cement grout.

e. Description of the methods and equipment for accurately monitoring and recording the grout depth, grout volume and grout pressure during grout placement.

f. Methods of complying with all applicable environmental regulations.

3.2.2 The Engineer will evaluate the Installation Plan for conformance with the plans, specifications and this special provision. Within 21 days after receipt of the plan, the Engineer will notify the Design-Build Team of additional information or changes needed to meet the contract requirements. Approval of the installation plan shall not relieve the Design-Build Team of the responsibility to install the micropiles in accordance with the plans and specifications.

3.3 Subsurface Information. The geotechnical information available to the Design-Build Team is stated in Section 7.2 of the Technical Provisions of the Request for Procurement.

3.4 Micropile Coordination Meeting. A meeting shall be held prior to initiating the micropile construction. The purpose of the meeting shall be to review all aspects of the micropile construction, and to facilitate coordination between all parties involved. Individuals attending the meeting shall include the Engineer, the Project Engineer from the Bureau of Bridge Design, the Geotechnical Engineer from the Materials and Research Bureau, the Design-Build Team and any Firm engaged to perform the micropile work and all other personnel deemed appropriate by the previously mentioned personnel. The Bridge Design and Geotechnical Engineers shall be notified at least 7 days in advance.

3.5 Micropile Tolerances. The DMPs shall be constructed to the following tolerances:

a. The center of the micropile shall be within 3 inches of the plan position in the horizontal plane at the top elevation of the micropile. (Note: the center of the micropile is defined as the center of the core pipe).

b. The top elevation of the micropile, including the permanent casing, grout and core pipe shall be within 1 inch plus or minus from the top elevation indicated on the plans.

c. The axial alignment of vertical and battered micropiles shall be within 2 percent of the design axial alignment over the total length of the micropiles.

d. The minimum and maximum micropile rock socket diameter shall be as indicated on the plans.

e. The bottom of the core pipe shall be located 3 inches plus or minus 1 inch above the design bottom of rock socket.

3.6 Micropile Drilling.

3.6.1 The micropile drilling equipment and methods shall be suitable for installing the micropiles in accordance with the contract design and construction requirements, through the subsurface conditions indicated in the boring logs and described in the contract. The micropile drilling methods shall also conform to the requirements described in 1.3.

3.6.2 Rotary or percussion drilling procedures that use internal flushing methods within the casing shall be required. Drilling procedures that permit loss of drill cuttings or fluid outside the casing, or that result in loss of ground outside the drillhole shall not be used. The Design-Build Team shall modify drilling methods, if any ground heaving, loss of ground, or damage to adjacent structures or services are observed.

3.6.3 Any void areas surrounding the permanent casing shall be backfilled with sand or grout in an approved manner.

3.6.4 Drilling within a 5 foot clear distance of a completed micropile shall not be permitted until the grout for that micropile has set for a minimum of 24 hours, or longer if an admixture that delays the grout set was used.

3.7 Steel Core Pipe Placement.

3.7.1 The steel core pipe may be placed either prior to grouting, or placed into the grout filled drillhole, provided it can be inserted through the grout to the required depth without difficulty. Core pipe that is partially inserted into grout shall not be driven or forced into the hole. The Design-Build Team shall redrill and then reinsert the core pipe when necessary to facilitate insertion.

3.7.2 Core pipe with a welded splice shall be placed in the drillhole with the splice located closer to the bottom of the drillhole than to the top.

3.7.3 The approved centralizers shall be used to maintain the core pipe tolerance criteria. Centralizers shall be securely attached to the core pipe so they do not shift during handling or insertion of the core pipe into the drillhole, and shall be in firm contact with the drillhole sidewalls. The centralizers shall be situated to permit insertion of the grout tube to the bottom of the drillhole, and also to permit grout to flow freely up the drillhole. The core pipe centralizers shall have a maximum spacing of 10 feet, and the end centralizers shall be located a maximum of 5 feet from the top and bottom of the core pipe. A minimum of 3 lines of core pipe longitudinal centralizers shall be provided for the vertical micropiles. Four lines of longitudinal centralizers shall be provided for battered micropiles with two of the lines located along the lower battered side of the micropile.

3.7.4 An approved method to restrain the upward movement of the core pipe shall be used to prevent uplift during grout placement. The elevation of the top of the core pipe shall be checked before and after the grout is placed. Approved corrective measures shall be implemented, if uplift movement greater than that allowed under Section 3.5 has occurred. No additional micropiles shall be constructed until the Design-Build Team has modified the

restraining system to prevent the uplift problem from recurring. Corrective measures shall be the responsibility of the Design-Build Team and shall be at no cost to the Department.

3.8 Micropile Grouting.

3.8.1 Grouting equipment shall produce a uniformly mixed grout free of lumps and undispersed cement, and shall be capable of continuously agitating the mix. A positive displacement grout pump shall be used, and shall be equipped with a pressure gauge that can measure at least twice, but no more than three times the intended grout pressure. The grouting equipment shall be sized to enable the entire drillhole to be grouted in one continuous operation.

3.8.2 All grout tubes and fittings shall be clean and free from dirt particles, grease, hardened grout, or other contamination before grouting is commenced for any micropile. All surplus water and diluted grout shall be flushed from all lines before commencing grout injection. The grout line shall be attached to the grout tube with suitable fittings so that leakage is prevented.

3.8.3 Prior to grouting, the drillhole shall be thoroughly cleaned of all drill cuttings, sludge and debris. After cleaning, the drillhole bottom shall be checked with a weighted tape or other means to confirm that the hole is clean. The micropile shall be grouted within 2 hours after the drillhole bottom has been checked and approved for cleanliness.

3.8.4 The grout shall be injected at the lowest point of each drillhole through a grout tube that is of sufficient strength to withstand the intended grout pressure. The diameter of the grout tube shall be sized to permit free passage of the grout material, and also to permit placement of the tube to the bottom of the drillhole.

3.8.5 The grout shall be injected at a pressure that is sufficient to overcome hydrostatic head and the grout column pressure, and which prevents unstable rock or groundwater from contaminating or diluting the grout. The grout pressures shall be controlled to prevent ground heave, rock fracturing or damage to adjacent structures or services. The injection pressure is subject to approval by the Engineer.

3.8.6 The grout shall be kept agitated prior to pumping. The grout shall be injected continuously from the bottom to the top of the drillhole, until uncontaminated grout flows from the top of the drillhole. Cold joints in the grout column will not be allowed. The grout shall be placed within 1 hour or less after mixing the grout, or within the time recommended by the manufacturer, if admixtures are used. Grout not placed within the allowed time limit will be rejected.

3.8.7 The Design-Build Team shall measure the grout quantity and grout pressures throughout the entire grouting operation. Grout pressures shall be controlled to prevent excessive grout loss into the surrounding ground.

3.8.8 Pumped grout volumes that are in excess of the theoretical volume of grout shall be at the Design-Build Team's expense.

3.8.9 Grout tubes that are left in the drillhole, shall be completely filled with grout. Grout tubes that are withdrawn shall be removed in a manner that prevents the creation of voids.

3.8.10 Grout Testing. The cement grout shall be tested by the Design-Build Team through an independent, certified testing agency for compressive strength in accordance with AASHTO T106/ASTM C109 at a frequency of no less than one set of three 2 inch grout cubes for every 5 micropiles, or once per day of grouting, whichever occurs more frequently. The grout samples shall be taken from the end of the grout line at the connection with the top of the grout tube, or as approved. The micropiles selected for the grout samples and the curing time for the compressive strength test shall be as directed.

3.9 Design-Build Team Records. The Design-Build Team shall keep a record of all pertinent data relative to the installation of the micropiles that is independent of the Engineer's records. This record shall be available for the Engineer's inspection, and shall be transmitted as directed. The Design-Build Team shall record the following information for each micropile:

a. Micropile location, date and time of drilling and grouting.

b. Drilling record including the drilling equipment, drill bit type and size, method of drilling, depth of overburden, description of the subsurface materials encountered (including weathered bedrock), depth of permanent casing, elevation of the bedrock surface, and the length of the rock socket.

c. Grouting record, including method of placement, total volume of grout placed, grouting pressures, grout mix, length of time for grouting, and results of grout compression tests.

d. Casing and core pipe installation record, including lengths, centralizer locations, and type and location of any splices.

e. Installation record, including the micropile total length, length of rock socket, axial alignment and horizontal location.

f. Details of any unusual ground conditions, micropile installation problems, or changes from the approved installation procedures.